CHAPTER TEN

THINGS

Give us this day our daily bread.

--The Lord's Prayer.

One of the most arresting singularities of human beings is our continual invention and deployment of, and attachment to, things. We make things, carry and consult them, teach each other how to use them, adorn ourselves with them, make gifts of them. Why?

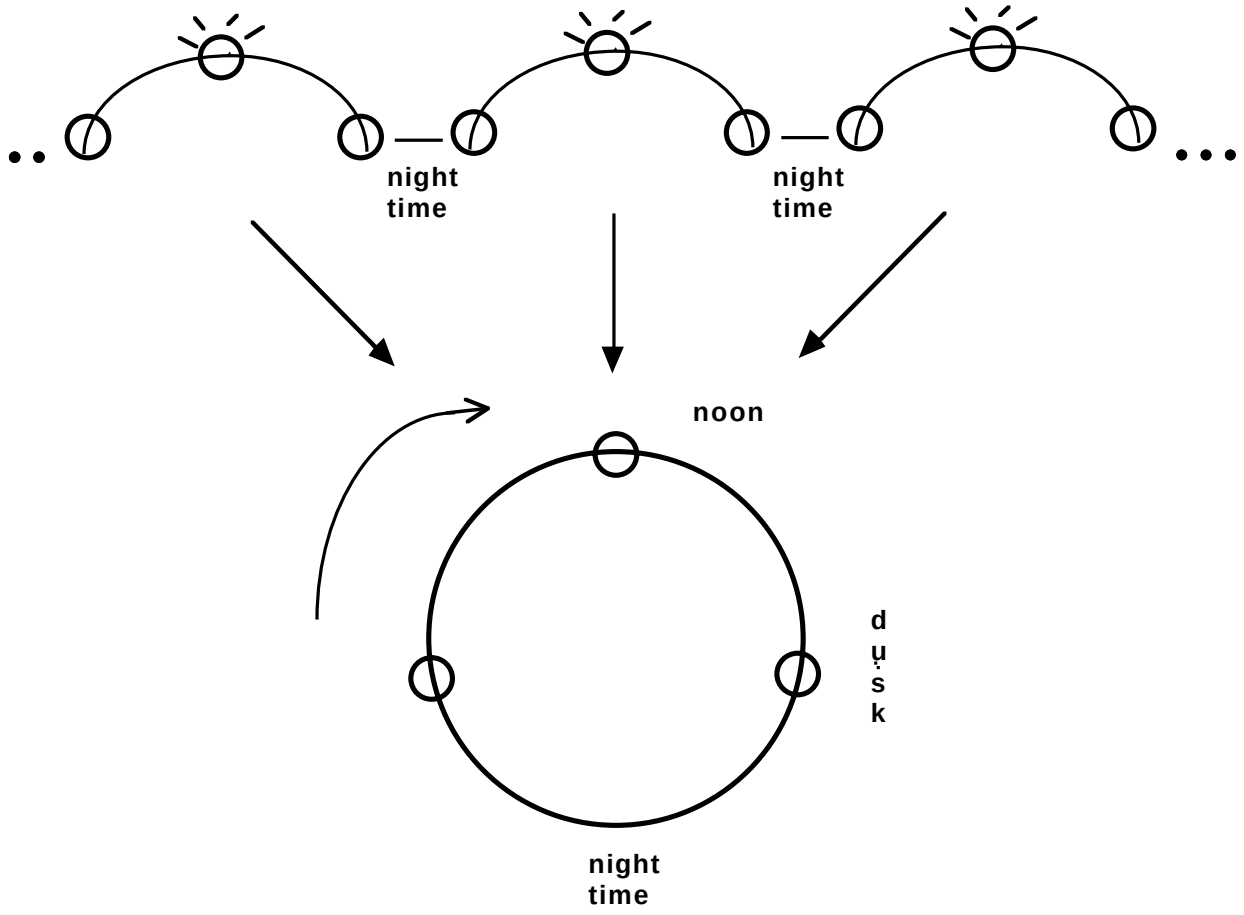
Consider a wristwatch. A watch is a few ounces of metal and glass, with complicated interior parts one usually cannot see, strapped around an appendage. It has two or three thin rods radiating from a center that go round and round at unequal rates. As a thing in itself it is bizarre and pointless, an extra weight for the wrist, a fragile object in a position where it can easily be broken. We cannot eat it; it does not keep us warm or cool; it does not hold a soothing drink. Why make, buy, carry, and consult it?

The cognitive anthropologist Ed Hutchins has studied with great insight the way in which material culture is suffused with conceptual blending of a type that typically employs everyday objects as material anchors.[i] Hutchins' examples include things like watches, sundials, gauges, compasses, sliderules. The wristwatch is a material anchor for a fascinating conceptual blend.

The first step in analyzing the watch is to consider the powerful integration network in our cultural model of time for a single day. This is a mirror network, with as many inputs as there are distinct days. It is a significant

achievement to be able to conceive of time as periodic. Days follow days, seasons follow seasons. The sun rises and will rise again tomorrow. We have analogy connectors running across all these days, connecting noon to noon, for example. In the generic space, there is a single abstract day. The corresponding times in distinct days are compressed in the blend into uniqueness, so that noon yesterday, noon today, and noon tomorrow in the different input spaces are felt to be the same noon in the blend. In each input space, a single day runs its course just once. In the generic space, an abstract day runs its course just once. But in the blend, *the day* perpetually runs its course and then starts again, going through the same progression of times: dawn, morning, noon, afternoon, evening, night. We will call this the Cyclic Day Network. In its blended space, we "reach noon *again*." Phrases like "your morning coffee," "swallows disappear and bats appear in *the early evening*," and "this park closes at *dusk*" pick out structure in the blended space of the Cyclic Day Network. This compression of outer-space analogy relations between the inputs into uniqueness in this blend uses the compression principle of fusing. Of course, there are many similar integration networks for different units of time, giving us blended notions of a week ("your weekly workout"), a month ("your monthly visit to your mother"), and a year ("your annual checkup"). In each of these networks, the inputs all have a similar unit of time, each of which runs its course just once. There are analogy connectors between times in the inputs, and fusing to create in the blend a natural unit of time that *repeats*, so that *the same unit of time* happens again and again. Each of these networks has linear time divided into equal segments in the input spaces, but cyclical time in the blend. The *outer-space* linear ordering of the inputs – successive days that can go on to infinity - is compressed within the blend into an *inner-space* cyclical ordering of repeated motion through the *same* unique day. The Cyclic Day is a remarkable compression that conforms

admirably to the Governing Principles and Overarching Goals that we discuss in Chapter 16. It compresses an infinity of time to the human scale of a single day; it compresses Many (all the mornings, all the evenings, all the "noons". . .) into One (the morning, the evening, noon, . . .).



THE CYCLIC DAY

Quite interestingly, in this network, we see inner-space time relations, that is the period from dawn to dusk, and outer-space time relations, that is, the "nighttime" that bridges day to day, compressed into a single inner-space temporal cycle. The open-ended sequence of outer-space nighttimes has become a single arc in the cycle.

The watch depends on the existence of the Cyclic Day integration network. One input to the integration network for the watch is the blended space in the Cyclic Day network (and that space stays connected to the rest of its network). The other input is the rotating rods—that is, the physical appearance of the watch itself, with the thin rods in a specific position and each of them moving. That input is also inherently cyclical.

The cross-space mapping is obvious if a little bizarre: one cycle of the Cyclic Day maps onto two cycles of the Rotating Rods. When the Cyclic Day reaches noon, the positions of the rotating rods point at 12. After two cycles of the Rotating Rods, it is noon again in the Cyclic Day.

Our modern understanding of time as consisting of a repetition of a periodic day is emergent in the blend for the Cyclic Day network. Our more specific understanding of time as consisting of a repeating day divided into hours, minutes, and seconds of equal duration is emergent in the Timepiece blend. In the cross-space mapping for the Timepiece network, each moment of the Cyclic Day is mapped onto a position of the rotating rods. In this cross-space mapping, the duration of an interval of time in the Cyclic Day corresponds to the length of an arc swept by a rod. In the blended space of the Timepiece network, the arc swept by a rod *is* an interval of time. A crucial emergent property is that equal arcs are equal intervals of time. This blended emergent notion of time is consistent because of human invention of a thing, a machine, that uses a periodic event like the rotation of the rods or the swinging of a pendulum. It is further important to be able to calibrate the machine so that it is always in the same position every noon. Once you have done that, you have automatically "divided" the Cyclical Blended Day into as many equal segments as the machine goes through from noon to noon. If we divide the watch face into k equal arcs, and there are n revolutions from noon to noon, we thereby divide the Cyclic Day into

"n times k" equal intervals. If n is 2 and k is 12, we have the conventional division of the day into 24 hours. If n is 2 and k is 1, we have the conventional division of the day into a.m. and p.m. Cultural evolution since Babylonian times has arrived at the universal convention of making k equal to either 12 or 60. The same watch can have markings for both 12 and 60 by dividing each of the 12 arcs into 5 equal smaller arcs. The little hand of the typical watch corresponds to n=2 and k=12. In the Timepiece blend for this hand, the motion of the little hand twice around the face of the watch, with identifiable positions at 1, 2, . . . 12, divides the Cyclical Blended Day into the 24 equal time periods we call "hours." In the different Timepiece blend for the longer hand on the watch, n=24 and k=60. This divides the Cyclic Day into 1440 minutes. In the yet different Timepiece blend for a third, thin hand on the watch, n=1440 and k=60, which divides the Cyclic Day into 86,440 seconds. It is an extremely impressive cultural achievement with incalculable consequences for human life and knowledge to have developed these successive compressions of the Cyclic Day and the Periodic Physical Event. The deep conception of time that emerges is so compelling that we take it to be part of the fabric of time itself. We find it intuitively obvious that time is divided into equal intervals that repeat day after day, year after year.

The watch is additionally ingenious in exploiting the fortunate facts that there are the same number of seconds in a minute as there are minutes in an hour, 60, and that 12 is a factor of 60, so that the second hand ends up exactly at twelve after one minute, the minute hand ends up exactly at twelve after one hour, and the hour hand ends up exactly at twelve after one day. The watch itself is a material anchor for all three Timepiece blends—the one with n=2 and k=12, the one with n=24 and k =60, and the one with n=1440 and k=60.

Ed Hutchins points out that the watches we have today are historically the product of many successive blends, beginning with sundials. "There is an obvious link," he notes, between compasses, clocks, and dials in general. All of these blends integrate frames of time with frames of direction.

GAUGES

The pattern of blending linear scales of any magnitude with markings on a compressed circular object was extended throughout the history of gauges. We have circular dials with pointers for a host of technical measuring and navigation instruments: the radio tuner, the speedometer, the tachometer, the altimeter, the barometer, the oven temperature knob, the oven thermometer, and the thermostat. All these gauges seem simple and transparent, but they are quite complex. Consider, for example, the oven temperature knob. It indicates not the temperature of the oven but the temperature we would like the oven to be. But we also sometimes want to know when the oven has reached that temperature, as when we want to bake the salmon for a few minutes at 550 degrees but not at any lesser temperature. So ovens often have an "idiot light," that comes on when the oven is actually at the set temperature. Before the light comes on, the arrow points to a temperature in a desired mental space. As soon as the light comes on, it points to a number on the knob that corresponds to the desired temperature in a hypothetical mental space. In the case of the thermostat, the two gauges for the desire space and the reality space are superposed in the instrument, one hand for each space, and they share the same dial and its calibration.

Hutchins points to the superb selective projection involved in reading aviation dials.[ii]

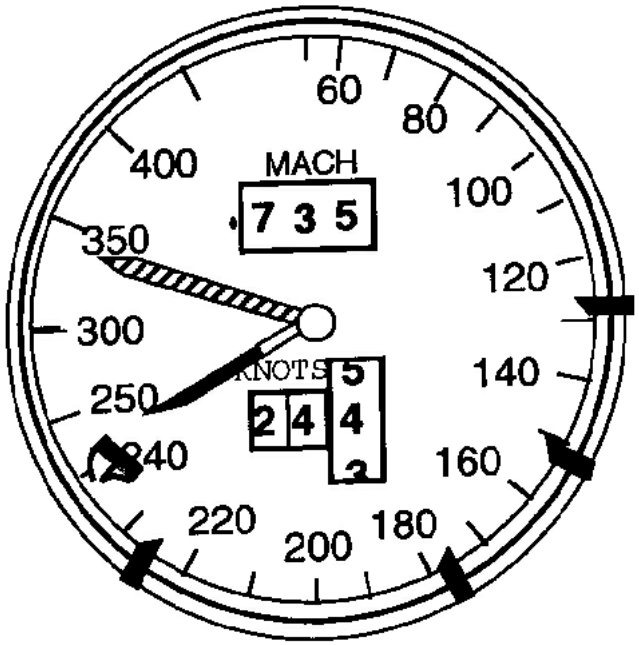


Figure 10.1

The dial in Figure 10.1 is giving the pilot information on when to reconfigure the wings for lift by positioning the slats and flaps on the wings. The appropriate configuration of slats and flaps depends on the speed of the plane and on its gross weight, which varies with the weight of the cargo on a particular flight and the present weight of the remaining fuel during a particular flight. After initiation of the descent from cruise altitude and before reaching a certain altitude, the pilot prepares the landing data. This involves determining the gross weight of the airplane and locating in some reference work the appropriate speeds at which the wings should be reconfigured for that weight. The pilot then moves the four clips, called "speed bugs," that are mounted on the rim of the speed gauge to mark off the speeds at which the wings are to be reconfigured. Then, during descent, the pilot need no longer worry about the specific speed of the plane or the gross weight of the plane.

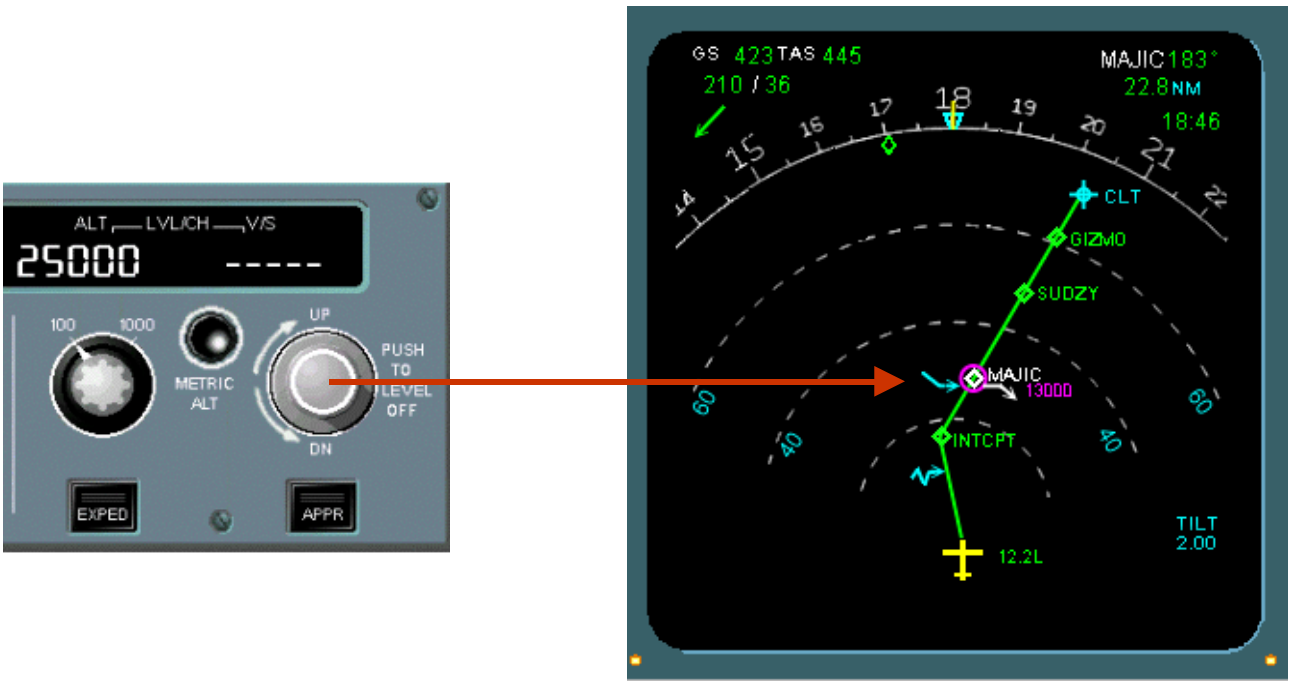
In the blend anchored by the instrument, the emergent structure is that if the hand is pointing between two particular clips, we want the slats and flaps to be in the corresponding configuration. Crucially, this structure is invariant from flight to flight and gross weight to gross weight, so that cognitively, once the clips are set, the pilot need only live in the blend. Here we see an example of modifying the real world by setting the clips in order to keep a conceptual structure constant in the blend. This blend has complicated connections to other spaces, but once he has set the clips appropriately, the pilot need not activate those connections while flying in order to succeed. In flight, all he needs to do is reset the slat-and-flap configuration when the dial is pointing at the clip.

Modern planes have linear digital displays:

Ironically, as Hutchins shows, they do not reflect perceptually at human scale the differences in speed and positioning of slats and flaps, even though formally they contain all the information. For the old gauge, the gross physical configuration of the display was different for different speeds, and different entire regions of the display corresponded to the different positioning ranges, but in the new display, the gross physical configuration of the display does not change.

We take the dials for granted as simple, obvious objects, but replacing them by sophisticated and in some cases more accurate digital displays can reveal that they were supremely efficient compressions.

Modern displays also show remarkable emergent structures and compressions to human scale, most of them intended by the designers, but some discovered by the users. Barbara Holder discusses the case of the "blue hockey stick" in the Airbus 320 flight control display. The blue hockey stick is a small, crooked blue arrow on the screen that displays the course of the plane. It shows the point on the future precomputed path of the plane at which the desired altitude will be reached under the current settings. During descent, the pilot will be cleared for a certain altitude at a certain geographical location. He wants to achieve that altitude by the time he reaches that location. In vertical speed mode of descent, the pilot can alter the altitude of the plane by manipulating the vertical speed knob, whose setting indicates the desired vertical speed. Manipulating the vertical speed knob has the effect, through the computation done by the plane's instruments, of changing the point on the flight path where the desired altitude will be reached. Since that point is indicated on the display by the blue hockey stick, the blue hockey stick will move when the knob is turned. This is a fabulous compression that allows the pilot to work directly in the blend—the pilot simply turns the vertical speed knob to move the blue hockey stick to the desired location on the flight path display. This compression is not taught to pilots, but some pilots discover it. Barbara Holder quotes one who did: "And what I do in a case where they [Air Traffic Control] give you a crossing restriction, I use that blue hockey stick, and just roll the vertical speed to wherever you think it should be and see where the blue hockey stick ends up, if that looks right on the map display on the nav display away you ago."[iii]



Direct connection between vertical speed knob and arrow

MONEY

A watch is useful because of its mechanical functioning. The conceptual network required to understand the watch is one we can carry in our heads. Alone on a desert island, we might be very thankful for a watch.

Money is a material anchor with different features. It too depends upon an elaborate conceptual network, but one that can only be supported socially. The mechanics that make money useful are in the society rather than the money. Alone on a desert island, we would find a dollar bill to be nearly worthless.

The history of money, like that of watches, is complex and involves very many successive blends, now long forgotten. But we can look synchronically at the concept of money as we looked at the concept of time materially anchored by timepieces. To get a taste of how this analysis would go, we will outline a much simplified integration network for money. Take one input, the GOODS, to be the set of things that can be needed, traded, desired, inherited, given, stolen, or in some way transferred from the possession of one agency to that of another. Now take a second input, the VALUES, to be a metric scale using an arbitrary unit of measurement. Value scales are widely available: we can speak of something being three times as beautiful as something else or of someone being ten times as smart as someone else.

The GOODS input typically has a local value structure of its own: a cow may be worth 20 chickens and three chickens worth so many yards of cloth. Most goods, however, cannot be directly compared — a fisherman has no reason to exchange his net for a farmer's plough.

Goods are mapped onto the Value scale in such a way that topology of values is preserved across the inputs. So if the plough is worth two cows to the

farmer, and the fisherman is willing to give 30 salmon to a weaver in exchange for a net or for a piece of cloth that is worth 10 chickens to the weaver, and one salmon is mapped onto position 2 on the value scale, then for consistency and preservation of local topology we must map a net onto position 60, a cow onto 120, a plow onto 240, a chicken onto 6 and the piece of cloth onto 60. The obvious consequence of projecting a full Value structure onto the Goods input is to implicitly define exchange standards for the entire domain of Goods. Clearly it would take three salmon to get a chicken, four nets to get a plough, and two pieces of cloth to get a cow. The mapping generalizes exchange but does not simplify it — one would have to always travel with salmon and hope that the farmer or the weaver likes fish.

The amazing step in the invention of a true Money network is to bring in a third input with objects that have no place in the original system of exchanging goods, like identical pieces of colored paper. In the simplest case, the new objects are identical tokens. We map each token onto the same position on the scale in the Value input, say position 1.

We project all the objects from the GOODS input and the tokens from the new third input to the blended space. We also project all the values from the VALUES input, so that every element in the blended space now has a value, including the new objects; the new objects are now collectively called *money* and individually given a name, e.g. *dollar*. The exchange system is projected from the GOODS input and in the blend applies to all objects that have value. Therefore, money can participate in the exchange system. In the input spaces, the relation of goods to values is a complex derived computation, as we saw for the chicken and salmon. The outer-space connections between the three inputs—of goods, values, and arbitrary objects—provide a complicated way to compute connections between the exchange relations of goods. But doing this

computation requires not only arithmetic, but also polling the entire community to discover what exchanges are acceptable. In the blended space, these outer-space connections are compressed into simple properties of the objects. Each now has an intrinsic value. In the blended space, knowing the simple value replaces doing the arithmetic and conducting the poll. In the standard buying-and-selling scenario, there is the further constraint in the emergent structure of the blend that one of the exchanged objects must be money.

The elementary social structure of buying and selling as we know it emerges in this blended space. The objects that count as money have many special properties: for example, there has to be legally enforced public consensus on the value and nature (minting, etc.) of these special objects; the culture will make objects that are easy to carry, not easily degradable, distinctive, and easily recognizable. Complex financial and economic structures appear in the social practices that are part of the blended space.

Historically, the leap to the money network has always required elaborate cultural steps, especially the intermediate step of selecting as the object that will count as money something that is easily measured and transported and also easily incorporated into the exchange system of goods, such as a weight of

precious metal or measure of spice. In retrospect, when we look at the culturally mature network for money and start to think about it, it can seem amazing that anybody ever swallowed it:

> But what do we mean by worth? When we use the word, we are talking about a system of equivalencies—a transaction between the symbolic and the actual that many people believe is the most real thing there is, but which is, in fact, a sheer act of the imagination. Whose idea was it that a hard, inedible, and unprotective substance (stones, shells, metal) could be traded for food, clothing, shelter? The use of money is the purest act of faith; no anchorite who has followed a vision into the desert has acted on an idea as far-fetched as our belief that if we put a dollar in a machine we will be drinking a Diet Coke in a minute.
>
> —Mary Gordon, *The New York Times on the Web*, 4 June 2000.

Although our account of the development of the money network is outrageously simplified, it illustrates our main point. Money, in the form of bills and coins, provides a key material anchor for a tight compression of the notion of goods and how to exchange them. The socially sanctioned production of a simple material object provides a material anchor that radically reorganizes social practice, with dramatic consequences for human culture generally.

TOMBS, GRAVES, AND ASHES

In the Homeric epics, the martial élite cremates its honored dead, while the common folk bury their dead and tend the graves. We still maintain these traditions, both of which can leave us with a material anchor for the departed

person. In one case it is ashes in a mausoleum or in an urn on a shelf at home, in the other case it is a "plot" of land with a tombstone.

In the previous chapter, we presented the hypothesis that striking singularities of cognitively modern human beings arose from "double-scope" blending. That hypothesis applies equally to the invention of burial rituals and, more generally, to the invention of the concept of living with the dead. The archeological record suggests that such treatment of "the dead" also arose roughly fifty thousand years ago. In the network for "the dead," one input space has the person when alive, and the other input mental space has the remains, typically looking as much as possible like the living person just before death. Some burial practices are meant to ensure that the remains have this appearance: embalming, death masks, sarcophagi, cosmetic techniques used by morticians, dressing the body in its best clothes, and providing it in the casket with its characteristic accessories. Many vital relations connect the input space with the person and the input space with the remains: the person and the remains are causally related; they are also related by physical change; they can be related by disanalogy as in the case where the person moves but the corpse does not. The body is a part of the person in the input with the living person, so there is a physical relation of change between the body-as-part in one input and the corpse in the other. There is also strong literal similarity between the body-as-part and the corpse. In the input with the living person, the body and the soul (or, if you prefer, the intentional aspect of the person) are inseparable. In the blend, we have a being who has some intentionality projected from the space of the living person, and so might, for example, have some of the living person's memories, interests, and psychological characteristics. The blend has, typically, the temporal moment taken from the present mental space with the remains. The outer-space disanalogy connector between the inputs—the person was vital but

the remains are not—is compressed into an *absence* inside the blend. The dead person in the blend is an absence, felt as such, but with projections from the space of the living person.

In the blended space, *person* has been projected from the input space with the living person, and the complex structure of input spaces and outer-space connections has been compressed into the inner-space property *dead*. *Dead* is like *safe*: it prompts for a complex network. And once the blend for *dead person* has become entrenched, it can serve as an input to a standard extension of the category *person*, so that now the category includes dead people, whose help we implore, whose wrath we avoid, and whose advice we seek.

Personal identity itself involves a diffuse network of mental spaces whose compression in the blend creates the unique person. Conceptually, a person is involved in mental spaces over many times and places, through many changes. All those spaces contribute to a blend that has the single unique person. There is a physical material anchor for this conceptual blend—the active living biological body which we can see and with which we can interact. We can hear its voice, and it can hear ours. When the person dies, the conceptual network with the unique person persists for us, if not for the person. But the material anchor is gone.

The complexity of the conceptual blends involved with dying and the dead, and of the material anchors for these blends, is immense. We point here only to a very few striking ways in which material anchors are used to develop such blends to make the dead, although absent, accessible. Cemeteries and tombs are part of the real world and have their own physical organization. But their importance lies in the role they play as material anchors for the blend of "living with the dead." The projections are relatively straightforward. Since the living person's body is mapped onto the corpse, a place where you might

encounter the living person, i.e. a place where her/his body might be, is mapped onto the place where the corpse "is" — the grave. We project from the space of the living person the notion of establishing contact with the person, and from the other input the place where that contact is best established — the grave marked by the tombstone. This simple material anchoring of the blend provides the necessary implements for such widespread cultural practices as paying honors to the dead by putting flowers on graves, visiting graves at regular intervals or on publicly chosen days like All Saints Day, and above all communing with the dead and even talking to them on the site where "they" were buried. In the double-scope blend, the dead exist as a category, whose elements are both present and absent.

The transition of death progresses from living person near death, to the person who has just died, to the mortuary preparation, to the visitation of the body, to the funeral, to the burial, to communing with the "departed" at the grave. Right after death, the corpse itself is a very powerful material anchor for the complex integration network of the person's personal identity, and as such, it is treated in elaborate ritual ways so as, on the one hand, to deal with the fact that it is dead organic matter, and on the other hand, not to dishonor the person for whom it is serving as temporary material anchor. During that period, the corpse is the material anchor for "making contact" or "communing" with the person. Wakes and *veillées* and other rituals designed to prevent the corpse's being left alone before burial are themselves blends of care for the living and dealing with the corpse. Once the corpse is buried, it does not serve as a material anchor. That role shifts to the tombstone and the grave plot and the cemetery, with its other graves and possibly with a chapel or church. In establishing contact with the dead years later and communing with them over their grave, we

typically use memories of the body just before burial, and we typically think of that body as inhabiting the grave, not of the actual contents of the coffin.

In Catullus's farewell elegy to his brother, the material anchor is the ashes in the vicinity of the death:

> multas per gentes et multa per aequora vectus
> advenio has miseras, frater, ad inferias,
> ut te postremo donarem munere mortis
> et mutam nequiquam alloquerer cinerem.
>
> Across many lands and seas I have come, brother, to your sad funeral rites, to offer the final gift to the dead, and speak in vain to your mute ashes.

In the blend, there is a unique element that corresponds to the brother in one input and the ashes in the other. By the first projection, Catullus can call it "brother" and "you" ("frater" and "te"). By projection from the ashes, it cannot respond to Catullus. In the blend, the brother does not respond, therefore he is mute, and therefore the ashes are mute, even though in the input, absent the blending, ashes cannot be mute. The ashes in a fireplace do not speak to us, but nobody would call them "mute."

CATHEDRALS AND THE METHOD OF LOCI

Graves are not an isolated case. Enormous amounts of human time, energy, and talent go into building material anchors for spiritual and personal integration networks. Robert Scott has written a book-length study of "the idea

of the Gothic cathedral" and its anchoring in actual Gothic cathedrals, with their furnishings and rituals, in actual physical sites.[iv] Just as the grave is a material anchor for communing with the relatively inaccessible dead, so the cathedral is a material anchor for communing with the relatively inaccessible world of the divine and the departed.

In the case of a grave, the place where the corpse is buried has a natural and inevitable link to the dead person. In the blend of living with the dead, the dead person is naturally available at the grave. In the more general case of the sacred, according to Scott, the goal is "to draw sacrality to the community." There is no a priori reason why the sacred should be drawn to any particular place. In Robert Scott's words, the sacred is conceived of as a "diffuse, ubiquitous, pervasive but unfocused force," that is "so to speak, hovering about in the atmosphere." One of the purposes of the cathedral is to attract the sacred and focus it in a particular location. This requires the "creation of a habitat for the sacred, a special place and an environment to which sacrality would be drawn and kept in place in such a manner that its potential to evanesce or migrate would not be realized."

The cultural and perceptual experience of the cathedral and its site must conduce the community to activate a blend that gives them a sense of the sacred. Somewhat obviously, the cathedral has features of grandeur, size, degree and quality of light, difficulty of construction and maintenance, patterns of music and prayer, and other elaborately scheduled rituals that distinguish it from any human-scale practical building and that associate it with the cultural conception of the sacred. Less obviously, there are mental and cultural integrations that go far beyond the visible aspects of the cathedral. The concept of the cathedral is linked to aspects of imagination and memory that increase its effectiveness many times over as a material anchor for sacrality. Scott's hypothesis for how this

happens depends upon a mental instrument that has long been recognized within Western rhetoric.[v] This instrument is the "method of loci."

In the method of loci, someone needs to remember a complex organization of ideas, perhaps to deliver later in the form of a speech. She does this by associating the ideas with locations on some familiar path and then remembering and expressing the ideas by imagining that she is going through the locations on the path. One input space has the ideas, the other has the familiar path, and there is an Analogy mapping between two well-ordered sequences in the two input spaces.

For example, if you need to memorize an after-dinner speech, you might think of the path from the front gate of your house through the porch, the front door, the rooms, the back door, and into the yard. Then, attach each of the ideas or actions in order to the places along the path. So the thanks you give to those who have invited you is the gate to your front yard. The "opening" joke you tell is the opening of that gate, and so on through the entire dinner speech. Then, nervous at the podium, all you need to do is take a mental stroll through your house to remember what you need to say when. Hutchins provides an insightful analysis of this method as involving a layered blending template:

> The method of loci provides a well-known example of the cognitive use of material structure. In order to remember a long sequence of ideas, one associates the ideas, in order, with a set of landmarks in the physical environment in which the items will have to be remembered. The method of loci sets up a simple trajectory of attention across a set of features, let us call them landmarks, of the environment. One may establish a flow through the environment that brings attention to the landmarks in a particular order. This is a layered blend. The initial input spaces

> are the shape of the motion of a trajector and the set of landmarks in the environment. Together these produce a blend that is the sequential flow through the landmarks in the environment. The sequential relations of the landmarks arean emergent property of the blend. This space then becomes an input space for a more complex blend. The items to be remembered are associated with the landmarks, producing a space in which the items to be remembered are imagined to be co-located with their corresponding landmarks. In this blended space, the items to be remembered acquire the sequential relations that were created among the landmarks. These sequential relations among the items to be remembered are an emergent property of this compound blended space.[vi]

This method was part of the art of memory, developed by Cicero and others and practiced since classical antiquity. Hutchins finds examples of the method of loci in many cultures. For example, "in the Trobriand Islands of Papua New Guinea, long narratives are structured around local geography." Since the adults know the geography, the progression of the protagonist along a familiar path associates the order of the locations along that path with the order of the parts of the story, making the long narrative much easier to remember.

In Hutchins' examples, the material anchors used in the method of loci already exist. The Gothic cathedral, Scott argues, is a different case. The idea of the cathedral begins from an input space with theological content and an input space with a building. The method of loci is used to create a blend in which the theological organization is fused with the order of locations as one moves through the building. But then, strong emergent structure arises in this blend: the building becomes modified in imagination so as to accept topological

projections from the theological space. Over generations and generations, theologians elaborate this blend, and those who present the theology use it. The result is a fabulous emergent concept, that is, the Gothic cathedral, a structure which in many complex interacting ways is fused in the blend with Christian theology. The cathedral, Scott argues, although based of course on knowledge of antecedent places of worship, exists first as a mental construct, which is only secondarily given a full material anchor by actually building one. Scott explains how extensive knowledge of sacred texts guided monks "toward an immanent experience of the Divine" "Imaginary monastic schemes" were devised for remembering those sacred texts that

> had a locational quality in the sense that they provided a place for everything and assigned everything to its place, and that the metaphors employed for doing this were architectural. Since the materials that were meant to be accessed (i.e., the sacred texts) were used for purposes of mediation, this meant that in using them, the practice of the art of memory required the practitioner to engage in imaginary movements through *imaginary spaces*. (Our emphasis.)

Scott reports the examples given by Mary Carruthers in *The Book of Memory* of how the art of memory worked. He writes,

> One involved a monk, Peter of Cellar, who imagined an entire monastery in this way and invited his audience to enter and use it together with him. Another example she gives is that of Hugh of St. Victor whom she described as being ". . . careful to show exactly how each piece (of his imaginary building) is articulated in the scheme of the entire structure, and how the story and rooms are divided in them to 'place' information in the form of images

> within these divisions, used as mnemonic loci. . . . Hugh saw this building in his mind as he composed: he 'walked' through it and…he used it himself as he advised others to, as a universal cognitive machine."[vii] A third example is Augustine of Hippo, who, in his sermons, painted a literary picture of a tabernacle and then invited his fellow monks to look around and walk about it with him.
>
> Perhaps the most famous example, famous in part because it survives, is the Plan of St. Gall, an actual drawing of a plan for a wholly functional monastic community that provided the ideal space for engaging in liturgical processions and meditation in pursuit of the path to enlightenment. Significantly, though it was never actually built, it was in fact used in imagination by the monks of St. Gall as a space in which to meditate individually and as a community.

The cathedral is developed as a conceptual structure in the blend before it has an accurate material anchor to support that blend. The material anchor, once constructed, supports the mental activities of monks but also makes it possible to communicate that conceptual structure to the lay community, and to organize their activities, much as watches and money now organize the actions and interactions of people in a society. Over centuries, the conception of the cathedral, the building of the cathedral, and the actual use and existence of the cathedral culminate into an optimal compression.

The cathedral, like places of worship in general, contains many varieties of material anchors, all coordinated: vestments, candles, special chairs and benches for special activities, confessionals, stations of the cross with their own use of the

method of loci, altars, sacristies, visual images, graves, and books. To the uninitiated, this collection of material anchors can look like a bizarre and unaccountable assembly, but someone raised in the tradition will have the means and competence to unpack and decompress what is actually a very powerful blend, culturally evolved through centuries of worship.

We grow so used to interacting with material anchors like money and watches that the compressions they provide seem almost as complete and obvious as the compressions provided by biology, like the perception of the blue cup. When we see banknotes exchanged for bread, the fact that one is money is as obvious as the fact that one is bread. But to the cultural outsider, such things can look entirely mysterious. The outsider who enters the cathedral lacks the elaborate conceptual integration networks that make it possible to see the material anchors for what, in the compression, they are. To the faithful, the cathedral—with its altar, its vestments, its candles before statues—is as immediately understandable as buying bread with money or seeing a blue cup.

We began this book by looking at networks that do not seem to require material anchors: counterfactuals, metaphors, the riddle of the Buddhist monk, the Debate with Kant. Following Hutchins' lead, we have now turned to conceptual integration networks that seem to require the material anchors in order to be manipulated mentally: it is hard to imagine a society using "conceptual money" as an effective medium of exchange without any material anchors in the form of bills, coins, numbers in account books, or electronic banking devices. Barbara Holder discusses successive blends in the development of the Automated Teller Machine.[viii]

But is there a clear difference between conceptual integration networks that require material anchors and those that ostensibly do not? Let us turn to

cases where the material anchors are less obvious than money or watches. We begin with writing.

WRITING

Writing hardly seems the same kind of thing as a watch, a coin, or a cathedral. Yet when we look at it, we see physical marks on stone or paper or a computer screen, and these marks are circulated through the community. By themselves, these marks are meaningless: if we could send a sheet of writing back ten thousand years to a tribe of cognitively modern human beings, they would not have the slightest idea what to do with it, although the sheet would be a marvel. But we have elaborate conceptual and linguistic mental systems that can use these marks in culturally supported ways. Just as we look at the watch to see what time it is, we look at a sentence in a letter to see what someone is saying to us.

The blend seems natural to us even if it is immensely rich in its projections and elaborations. Suppose a woman is reading a letter from her fiancé, a soldier at the front. What is she doing? From one perspective, she is looking at and distinguishing marks on a sheet of paper. But a lab rat or a pigeon can probably distinguish marks on a sheet of paper, and she is clearly doing something the lab rat or the pigeon cannot. There is one input in which the woman is alone, looking at a material object. There is another with the fiancé and his general capacity to speak to her. In the blend, her fiancé is speaking to her. The projections are selective and imaginative. It is emergent structure that they cannot answer each other in all the usual conversational ways, and that there is no audible sound from the fiancé. The fact that the writing consists of words comes from the space of speaking. The specificity of those words/marks comes

from the space with the specific marks on the paper, combined with a general mapping, evolved by the culture, for connecting equivalence classes of sounds to equivalence classes of marks—that is, connecting the mark "boy" to the sound *boy* (or, more precisely, a category of marks like boy, **boy**, *boy*, boy, Boy, BOY, boy . . . to a category of sounds that consists of all the ways of pronouncing the word *boy* —with high or low pitch, with a British or Australian accent, in a whisper, . . .).

A proficient reader ends up with a general competence for constructing integration networks for writing and reading. One input has someone talking and the other has some medium with marks, and in the blend, the marks and the speech are fused in impressive ways. The emergent integrated activities of "expressing oneself through writing" and "understanding others through reading" are strikingly different from speech in nearly all aspects.

The writing and reading blend is of immense cultural importance to us. It cannot exist without the material anchors of distinctive marks on material substances. But the use of these material anchors depends on a very powerful prior conceptual blend that compresses a certain infinity of marks (boy, **boy**, *boy*, boy, Boy, BOY, boy, etc.) into a single entity, the written word "boy," and that entity itself is construed as identical to another compressed infinity, the spoken word "boy."

Once we have learned it, the writing and reading blending network seems simple and inevitable. But it includes complex projections and social conventions that we take for granted. For example, to read a book in English, we must map speech in time onto linearly ordered locations from left to right horizontally on the page, and understand that at the end of the line, the speech jumps back to the beginning of the next line, and that turning the page (the commonest action we take with a book) has no counterpart in the speech space.

SPEECH

Speech may seem immaterial, hardly like a watch or a cathedral or even an inscription on a tombstone. But in fact it is a material anchor. Consider the scene in which the woman is actually listening to the speech of her fiancé. He has returned unscathed, and they are having coffee in the kitchen. From one perspective, what is happening is that longitudinal waves in the air are striking her ear drums, and she is aware of this. But from the same perspective, a lab rat or pigeon would be doing the same thing, and again, she is clearly doing something they are not. For her, the longitudinal waves give rise to "sounds" that are like physical objects. Our ability to categorize sounds in such a way that two sounds count as the same for the purpose of communication accounts for the permanence that gives sounds the status of material anchors. She knows a complex mapping that connects particular equivalence classes of sounds to particular linguistic structures like words and clauses that are publicly shared and mentally represented.

The complexities of these conceptual integration networks are much greater than we have portrayed. One would need to bring in phonetics, phonology, and morphology to describe aspects of them. Our superficial description nevertheless hints at the type of blending that is going on in writing and speech and at the ways in which material anchors of various kinds are indispensable to the mental and social activity.

SIGN LANGUAGE

It is now universally recognized that language can have modalities other than voice. Spoken languages use oral-auditory modality, but sign languages

use visual-gestural modality. The structural and conceptual complexity of sign languages is of the same magnitude as that of spoken languages. Where voice is the indispensable material anchor for the public sharing and learning of integration networks in spoken languages, gesture is the equivalent material anchor for sign languages. But because the modalities are different, their material anchors show some interesting differences as well.

A number of distinguished scholars—such as Scott Liddell, Karen von Hoek, and Christine Poulin—have studied the ways in which connections between mental spaces are reflected and prompted for in the modality of sign.[ix] Liddell, who has explicitly studied blended spaces in ASL (American sign language), shows that mental representations of one's immediate surroundings constitute a special type of mental space, which he calls a "grounded mental space." The immediate physical surroundings are the material anchor for that mental space. Elements in this grounded mental space have corresponding physical locations in the immediate surroundings that can be pointed to as part of communication. Sign languages use blending and pointing in interesting ways to allow speakers to refer again and again in complex ways to the same referent. When the things being talked about are not physically present signers can make them conceptually present by creating grounded blends.

Liddell presents an analysis of a revealing case:

> [A] native speaker of American Sign Language is narrating, describing an interaction between the cartoon character Garfield and his owner in which Garfield is looking up at his owner. This immediately follows a section of the narrative in which the owner has just told Garfield that he has removed the batteries from the remote control for the television. The signer produces the two sign clause CAT LOOK-AT to describe Garfield's initial response

to the owner. The subject of the clause is the sign CAT. The predicate LOOK-AT is illustrated in Figure 4, Space B.

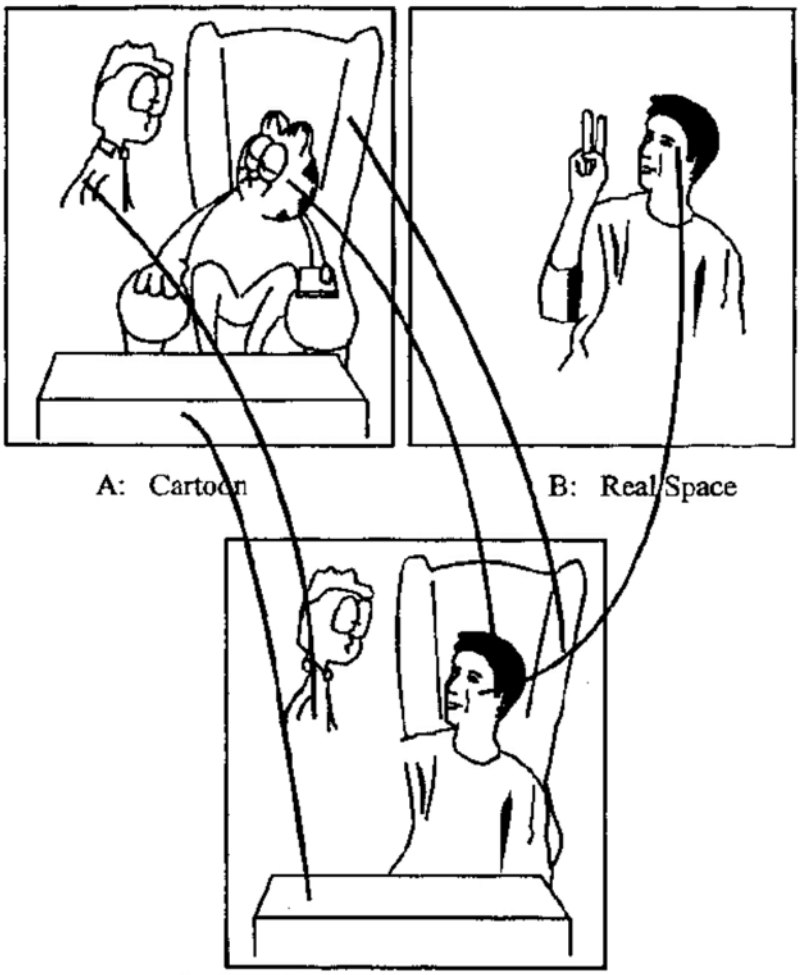


Figure 4. *A blend with signer as Garfield*

The meaning being expressed is that the cat is looking up and to the right (toward its owner). During the narration the real cartoon characters are not present. In order to explain both the direction of the sign LOOK-AT, the turning of the head, and the direction of the eye gaze in Figure 4, I propose that the signer's head position and eye gaze are no longer his own. Instead, they are demonstrations of Garfield's turning his head to the right and

looking up at his owner. The signer has also conceptualized Garfield's owner as standing to his right. This conceptualization involves blending elements from spaces A and B to produce the grounded conceptual blend shown as Space C.

Within the blend Garfield's owner is now standing to the right of the signer-as-Garfield and the signer looks up to the right in order to show that the blended character is making eye contact with the owner. This is no longer Real Space, because Real Space is a mental representation of only one's immediate physical environment. Here the signer's head position and eye gaze are to be interpreted as Garfield's head position and eye gaze in the blend. That is, the signer's head and eye gaze provide a demonstration of what Garfield did. So the signer has become Garfield, at least partially, since his head and eye gaze are conceived of as Garfield's. In Figure 4 lines connect Garfield in A and the signer in B to the blended Garfield in C.[x]

The living body of the signer has become the material anchor for an absent character, and a location where another character is absent is brought into play as a material anchor by pointing to that location. This is a blend of a present scene and an absent but reported scene. We take what we see as prompting for a blended space which we are to unpack so as to construct the input spaces, the connections between them, and the selective projections to the blend. A given element in the blend, such as the direction of gaze, is in one input the direction in which the signer is looking and in the other input the direction in which Garfield is looking.

Liddell points out that similar blends are also found in systems of gesture that accompany spoken languages, and indeed we find such blends involving

gestural material anchors so natural that we might have to think twice to see how complex these performances really are. They bring in the power of double-scope blending, which is an astonishing capacity that human beings take for granted because every one of us can use it easily, beginning from early childhood. We just can't help thinking that way.

CHAPTER TEN ZOOM OUT

Cultures have developed over time a range of things that prompt for elaborate conceptual integration networks.

— How does the child learn to use these objects? What capacities does the young child have, and what line of development does the child go through in coming to be able to manipulate all these integration networks?

Our answer:

In chapter nine, we discussed the evolution of the capacity for double-scope integration around the time of the Upper Paleolithic. But having a capacity is not the same as having its products. Human beings, equipped with the capacity for double-scope integration, had to go through the arduous cultural work of producing integration networks, using those networks as inputs to further networks. In retrospect, looking back at the cultural invention of a repertoire of blends, we may be able to pick out the developmental sequence, as in the development of speaking tens of thousands of years before the invention of writing, with speaking as an input to writing. We saw in the case of the development of numbers a long sequence in which each newly achieved number blend became and input to a later number blend. In this history, we need always

to keep in mind the distinction between the *operation* of conceptual blending and the *cultural products* of conceptual blending.

Clearly, the child learns very quickly what often took the culture centuries or thousands of years to develop—how to write or use money or use clocks. It might seem strange that what cultures struggled so hard with seems so straightforward to most of the children who must learn it. It might seem as if it should take longer for the child, or as if the culture should have moved much faster.

But in fact, recent work in psychology, in particular Jean Mandler's "How to Build a Baby," has shown that infants have developed complex conceptual systems long before they start talking.[xi] We know that the child comes into the world with double-scope capacity. We see from work like Mandler's that the infant as early as seven months old and perhaps earlier is already deploying powerful integration networks. At least as early as the stage of pretend play using props, and certainly no later than eighteen months, the child has clearly constructed robust double-scope networks.

With these capacities, the child comes into a world already populated with material anchors for the culture's conceptual blends. What for the adult is a blended space in an elaborate integration network comes to the child at first as a single integrated space. The child plays with money, toy watches, and books long before having the concepts of buying, telling time, and reading. Through imitation, the child can develop some of the routines for manipulating those material anchors before developing the integration networks they are meant to evoke. What for the culture is the blended space of an elaborate integration network can be for the child a starting point for acquiring that network. That space, by virtue of the constraints on integration, is at human scale, involving direct perception and action. This makes it a good place for the baby to begin.

The child is on the path of both acquiring networks that lie behind what its culture offers and developing new ones through blending of inputs.

The case is no different for language. The culture is using material anchors at human scale and all the directly perceptible features of the environment—from mother's voice to the baby blanket to the trees to the baby's own body and actions—to entrain the child toward the development of its repertoire of integration networks. There will be external evidence for the acquisition of these networks, in particular, the culturally appropriate manipulation of material anchors like intonation patterns, words, and phrases, simultaneously with and inseparably from gestures, facial expressions, eye movements, dress, handy physical objects, social interactions and anything else at human scale that can be manipulated as a prompt for constructing meaning. This view sets up a vast research program of investigating the particular networks and anchors and the development of the mastery of these networks and anchors that counts as cultural competence.

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[i] Hutchins. In preparation.

[ii] Hutchins 1995b. The diagram is from page 274.

[iii] Barbara Holder. "Conceptual Blending and the Airbus A320 Navigation Display." [WE NEED TO COMPLETE THIS CITATION.] The graphic is used by permission of Barbara Holder. [WE NEED TO GET PERMISSION FORMALLY.]

[iv] Robert Scott. In press.

[v] Hutchins. In preparation.

[vi] Hutchins. In preparation.

[vii] Carruthers 1990. Page 244.

[viii] Holder 1999.

[ix] Liddell 1998.

[x] Liddell 1998, pages 293-294.

[xi] Mandler 1992.